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Ease of Wheelchair Usage by Eye Controlled Device Implemented On Arduino

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Abstract— *Many people are suffering from quadriplegia around the world, which affects their four limbs. So in this project called Ease of wheelchair usage by an eye controlled device implemented on Arduino we make use of the advantage of their ability to move their eyes. The main aim of this paper is to create an efficient interface to identify the movement of the iris and to use the information obtained from this to control the direction of the wheelchair. We make use of a simple webcam to capture the eye movements by which the wheel chair can be controlled to move in the desired direction. Further adding on to this, for the safety of the user an ultrasonic sensor is mounted in front of the wheelchair to detect the obstacles and ends a signal that automatically stops the wheelchair movement. This is accomplished by interfacing with Arduino.*

Keywords— Arduino, Eye Controlled Device, wheel chair, Interfacing.

I. INTRODUCTION

Quadriplegia is a condition caused by a degenerative disease or a sudden condition that causes loss of movement from the neck down making it impossible to drive a manual or electric wheelchair, requiring another person to assist. In response to this issue a control device is integrated in a manual wheelchair. For that reason we design a system wherein a person sitting on this automated Wheel Chair with a camera mounted on it, is able to move in a direction just by looking in that direction by making eye movements. The captured camera signals are then send to PC and controlled MATLAB, which will then be send to the Arduino circuit over the Serial Interface which in turn will control motors and allow the wheelchair to move in a particular direction. In some applications, systems have been developed to map their nearby environment to avoid object collisions but they are expensive and require a large amount of data to be processed. Affordable devices that use ultrasound have been successfully implemented for navigating unknown environments.

II. PROBLEM STATEMENT

A detailed survey indicates that quite a percent of disabled patients having difficulties find it impossible in using a regular wheelchair although they have been given training in handling and operating the wheelchair. This indicates that they are lacked of motor skill and strength and difficult to operate a sophisticated wheelchair functions. Our system aims at user friendly product which requires no rigorous training. An individual may be prescribed a powered wheelchair for mobility upon meeting several criteria. For example, because the person does not have dexterous use of his/her upper extremities, a manual wheelchair will be inappropriate. A powered wheelchair does not require the physical contribution of the upper extremities, therefore it would be more effective for these individuals.

III. LITERATURE REVIEW

TITLE	AUTHOR	YEAR OF PUBLICATION	EXISTING TECHNIQUES
1.Eye Monitored Wheel Chair Control For Physically Handicapped	Ms.Humera Mujawar,Ms. Tanaya Patil, Ms. Pooja Patil, Mr. Dinesh O. Shirsath, Mrs. S. S. Sankpal.	International Journal Of Innovative Research In Computer Science & Technology (Ijircst) Issn: 2347-5552, Volume-3, Issue-3, May 2015	▪ Video Oculography (Vog) ▪ Infrared Video System (Irvs)
2. Automatic Camera Based Eye Controlled Wheelchair System Using Raspberry Pi	Dulari Sahu.	International Journal Of Science, Engineering And Technology Research (Ijsetr), Volume 5, Issue 1, January 2016,	▪ Infrared Oculography (Irog) ▪ Search Coil (Sc)
3. New Ems To Incorporate Smart Parking Lots Into Demand Response	E. Akhavan-Rezai, *Student Member, Ieee;* M. F. Shaaban, *Member, Ieee;* E. F. El-Saadany, *Senior Member, Ieee;* F. Karray, *Senior Member*	Robotics And Automation, 2004. Proceedings Icra '04. 2004 Ieee International Conference On Volume 1, 243– 248 Vol.1, 2004.	• This Approach Includes Real-Time Interaction Between The Aggregator And Pev Owners, Whereby The Aggregator Proposes A Number Of Offers And The Owner Responds Based On His/Her Preference
4. Eye Controlled Wheelchair Based On Arduino Circuit	Reona Cerejo, Valentine Correia, Neil Pereira	Department Of Computer Engineering , St. Francis Institute Of Technology, St. Johns College Of Engineering And Technology Mumbai University, Mumbai, India.	• The Idea Is To Create An Eye Controlled System Which Enables The Movement Of The Patient's Wheelchair Depending On The Movements Of Eyeball. • The System Is Affordable And Hence Can Be Used By Patients Spread Over A Large Economy Range.

IV. PROPOSED METHODOLOGY

4.1 System Overview:

1. Camera is fixed firmly on the wheelchair and laptop is used for tracking the movement of the users eye.
2. The Arduino board will entrap the camera signal detected by Matlab code from the laptop and convert the digital output to electric signals that will be directed to the wheelchair wheels for movement.
3. A signal triggered Wheel Chair.
4. Ultrasonic Sensor that calculates the distance of obstacles and sends signal to the wheelchair to halt it.

4.2 General Architecture and Description:

Movement of eye ball is tracked for the location of thre eye. Direction of the possible motion is found. Based on this direction determined, the command is transferred to the motor control device via Arduino. The eye motion tracking hardware is as shown in the figure 1:

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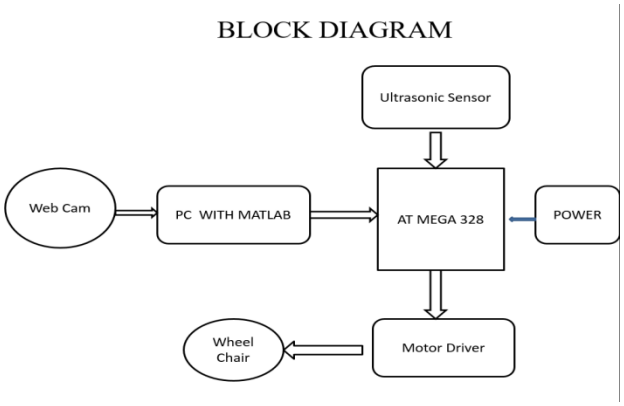

FIG1: BASIC BLOCK DIAGRAM

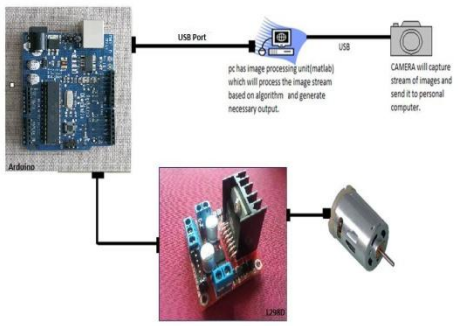

FIG2: SYSTEM DESCRIPTION DIAGRAM

Image Acquisition Device: It consists of a web camera with suitable interface for connecting it to PC.

Processor: It consists of personal computer or a dedicated image processing unit.

Image Analysis: Certain tools are used to analyze the content in the image captured and derive conclusions

Machine Control: After making the conclusion, mechanical action is to be taken

Arduino Board: Arduino board is used to pass the matlab signal to the motor driving circuit.

Motor Driver Circuit: Depending upon signal received from microcontroller it will send particular signal to DC motor in order to avoid drive wheelchair forward, backward, left and right.

In the MATLAB software, by image enhancement and other morphological operations is done on this eye position image. The MATLAB software generates different codes of different eye position. This code is send to transmitter on serial link. The transmitter consists of a encoder. Microcontroller sends this data to encoder. Encoder transmits data on wired link to the receiver. At the receiver end it receives the digital data. Again receiver section consists of a decoder. The received digital data decoded by decoder & output of decoder is given to the microcontroller. The microcontroller drives DC motors depending upon the decoded data and the wheelchair moves.

Ultrasound device different range finding techniques are used to estimate the distance to an object using an emitter and receiver. First, the emitter produces a beam and when an object is situated within the emission range, the beam is reflected toward the sensor. Finally, the measured beam is used to estimate the distance to the object. The beam speed is slow enough to use a time of flight distance estimation technique [13]. Knowing the beam speed and measuring the time between emission and reception of the returned beam, the distance the beam traversed is estimated.

4.3 Algorithm/ Method

The algorithm is based on Viola-Jones technique on identifying the input image by using a sub window enabled to detect features. It is designed to detect faces of varied sizes. Viola Jones introduced a scale invariant detector which runs through the image many times, each time with different size.

1. The system architecture of Viola Jones has a cascade of detectors. The first stages consist of simple detectors which eliminates only those windows which do not contain faces. In the following stages the complexity of detectors are increased to analysis the features in more detail. A face is detected only if it is observed through the entire cascade. These detectors are constructed from integral image and have like features shown below

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2. The first step of this algorithm is to convert the input image into an integral image. This is done by making each pixel equal to the entire sum of all pixels above and to the left of the concerned pixel. By doing so, sum of all pixels inside any given rectangle can be calculated using only four values.

3. Sum of the rectangle ABCD = D - (B + C) + A. The face detector in Viola Jones method analyzes a sub-window using features, which consist of two or more rectangles. Each gives a single resultant value which is calculated by subtracting the sum of the white rectangle(s) from the sum of the black rectangle(s).

4. To discard no face area, when a sub window is applied to cascading stages, each stage concludes whether the sub window is a face object or not. Sub windows which contain some percentage of having faces are passed to next stage and those which are not faces are discarded. Final stage is considered to have a high percentage of face objects.

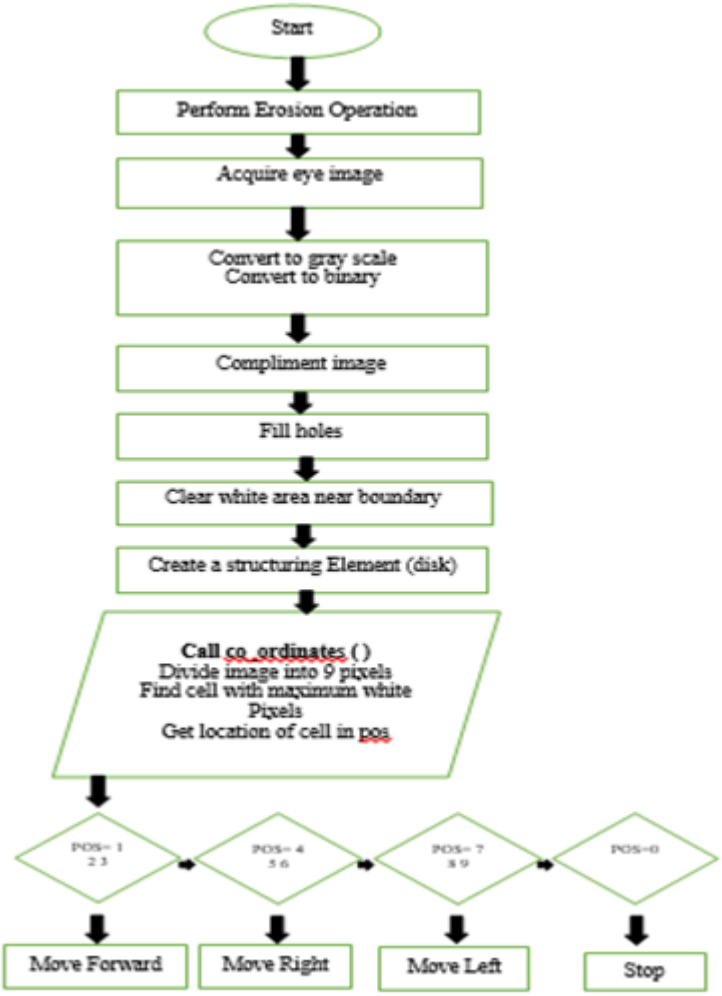

FIG 3:FLOW GRAPH OF THE SYSTEM

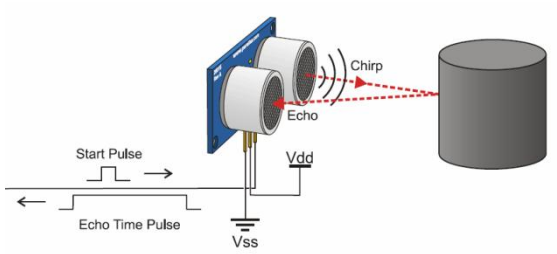

FIG 4: ULTRASOUND DEVICE

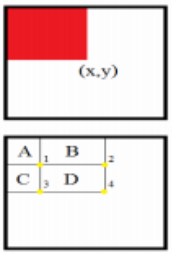

FIG 5A: WINDOW DETECTORS

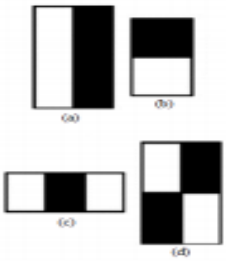

FIG 5B: SUB WINDOW

V. EXPERIMENTAL RESULT

1. The UI of the system is designed in such a way that it is easier for the people to use. Also it has the facility for adjusting the threshold according to the eye size for capturing the pupil movement.

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FIG 5: SNAPSHOT FOR UI

FIG 6: SNAPSHOT OF USER LOOKING LEFT

2. The input and its corresponding images shown below are produced after using Daugman's algorithm on input image for processing in MATLAB. The position of iris and pupil will be detected. And the position of the image is detected and the decision for the given below input image will be produced as LEFT or RIGHT respectively.
3. The input and its corresponding images shown below are produced after using Daughman's algorithm on input image for processing in MATLAB. The position of iris and pupil will be detected. And the position of the image is detected and the decision for the given below input image will be produced as CENTER and UPWARD.
4. In this system we present an innovation in ordinary wheelchair by adding motor type mechanism and making easier and simple wheelchair to handle by using eye motion tracking for physically disabled and paralyzed. The aim of this system is to contribute to the society in our small way by setting out an idea for a system which could actually better the lives of millions of people across the globe.
5. The future scope of this system would be to develop a mobile app to manage the wheelchair control. Also introducing home automation in the system would be an added feature of the wheelchair where a disabled person can turn on/off home appliances without getting up from his position.

FIG7: SNAPSHOT OF USER LOOKING RIGHT

FIG8: SNAPSHOT OF USER LOOKING CENTRE POSITION

FIG9: SNAPSHOT OF USER LOOKING UP

6. Ultrasonic Sensor that calculates the distance of obstacles from the wheelchair and sends a trigger signal to the wheelchair to halt it.

VI. CONCLUSION

In this project, we have assembled a wheelchair and included motors that can efficiently help the user for mobility with added security from obstacles with the use of ultrasonic sensor. This aims for the ease of lifestyle for patients with varied physical ailments.

The future scope of this system would be to develop an efficient mobile application to manage the wheelchair control. The other features that can be included are speed control and multiple direction access overcoming the limitation of only bidirectional ability. Also introducing home automation features so as the user can operate the home appliances directly from the wheelchair.

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